

REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and the following remark, is respectfully requested.

Claims 1, 5-7, 9-11, 15, 18-19 and 23-24 are pending in this amendment. By this amendment, Claims 1, 11 and 19 are amended; Claims 23 and 24 are added; and no claims are cancelled herewith. The amendments to Claims 1 and 11 are supported by at least page 18, line 8 to page 19, line 22. It is respectfully submitted that no new matter is added by this amendment.

In the outstanding Office Action, Claims 1, 5-7 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 11-260594 to Watanabe in view of U.S. Patent No. 5,234,526 to Chen; Claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Watanabe in view of Chen, as applied to Claims 1, 5-7, 10 and further in view of U.S. Patent Pub. 2001/0025607 to Lebar; and Claims 11, 15, 18 and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Watanabe in view of Chen and U.S. PG Pub. No. 2002/0038692 to Ishii.

Turning now to the merits, in order to expedite issuance of a patent in this case, Applicants have amended the independent claims to clarify patentable distinctions of the present invention over the cited references. Specifically, Applicants have amended Claim 1 to recite a plasma processing apparatus having an antenna including a plurality of slots for irradiating a microwave towards an inside of a chamber, a top plate member includes a dielectric flat plate portion formed to face the substrate, and a dielectric sidewall portion extends from a peripheral region of the flat plate portion towards the substrate, sides of the flat plate portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion and the sidewall

portion has a thickness not smaller than $\lambda_g/4$ but not greater than λ_g , λ_g being a wavelength of the microwave.

The Office Action acknowledges that Watanabe does not teach or suggest the features of the claimed invention discussed above. However, the Office Action asserts that Chen makes up for this deficiency and it would have been obvious to combine the teachings of the references. Chen discusses in col. 8, lines 49-63 that the thickness of the microwave-penetrable substance 9 is made equal to 1/4 of the wavelength inside waveguide 2. However, it is well established that “a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. See, for example, MPEP § 2144.05, citing In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). The record is devoid of evidence that the thickness of the sidewall portion as recited in Claim 1, is recognized by Chen as a result effective variable.

The specification of the present invention discloses that if the thickness of the sidewall portion is considerably thick, an interference pattern originating from a variation of a power density of the electromagnetic field is produced and the occurrence of two different interference patterns results in the variation of the interference pattern and makes the plasma generation unstable. Accordingly, in one or more embodiments of the present invention, the sidewall portion has a thickness not smaller than $\lambda_g/4$ but not greater than λ_g , λ_g being a wavelength of the microwave in order to stably produce the plasma. As such, the range of the thickness of the sidewall portion recited in Claim 1 has unexpected results as discussed above. Again, Chen merely discusses that the thickness of microwave-penetrable substance 9 is made equal to 1/4 of the wavelength, however, Chen does not discuss that above-mentioned technical features of examples of the present invention can be obtained by adjusting the thickness of the sidewall portion.

Further, in accordance with the features of Claim 1, the microwave propagates from the flat plate portion of top plate member to the sidewall portion of the top plate and then is supplied towards a periphery portion of the substrate, thereby enhancing a uniformity of a plasma density. In contrast, according to Chen, the plasma device as an electron cyclotron resonance (ECR) plasma device and is used to produce a plasma in the plasma formation chamber 104. The produced plasma is introduced the reaction chamber 108 through open end 104a of plasma formation chamber 104, and the plasma introduced into the reaction chamber 108 is used to process the substrate supported on a substrate support disposed in the reaction chamber 108. Accordingly, in Chen, since the plasma formation chamber 104 is separated from the reaction chamber 108 where the substrate is processed, Chen does not disclose that the microwave propagates from the flat plate portion of top plate member to the sidewall portion of the top plate and then is supplied towards a periphery portion of the substrate. Chen does not discuss the claimed features discussed above and therefore cannot provide the advantages of enhancing a uniformity of a plasma density in the radial direction of the substrate.

With respect to the features recited in Claims 5 and 19, a gas injection opening is disposed to inject the gas along the sidewall portion. The Office Action states that Chen teaches gas injection opening 3g for supplying gas into chamber along the side wall portion (Fig. 3). However, according to Chen, the gas injected from the gas supply tube 3g is introduced parallel to the surface of the substrate S, but it is not introduced along the side wall portion, as claimed.

Independent Claim 11 is allowable for at least the reasons discussed above with respect to Claim 1. Further, Claim 11 recites in part, a gap distance between the top plate member and the antenna is equal to or smaller than $\lambda g/10$. The present specification discloses that the gap is configured to be equal to or smaller than 1/10 of the microwave wavelength

because if there is a gap greater than $1/10$ of the microwave wavelength, distribution of the electromagnetic field inside the top plate unit 4 is changed by the electromagnetic field generated in the gap. See for example, page 13, line 26-page 14, line 5 of the present specification. However, for similar reasons as set forth above with respect to Chen and Claim 1, Ishii does not disclose above-mentioned technical feature obtained by setting the gap distance between the top plate member and the antenna to be equal to or smaller than $\lambda g/10$. As such, the claimed parameter is not recognized by Ishii as a result-effective variable. Further, the range of the gap as set forth in Claim 11 has unexpected result as discussed above.

New Claims 23 and 24 recite that all microwave irradiated towards the inside of the chamber are introduced through the slots and the top plate. In accordance with the claimed features, standing waves of the microwave are properly formed. In contrast, according to Watanabe, the microwave is irradiated to the inside chamber through the slots 8 of the antenna 6 and the top plate member 2, or only through the top plate member 2. Accordingly, Watanabe does not disclose that all microwave irradiated towards the inside of the chamber are introduced through the slots and the top plate, as claimed, and therefore Watanabe cannot provide the advantages of the claimed invention discussed above.

Accordingly, for at least the reasons discussed above, it is respectfully requested that the rejection of the claims under 35 U.S.C. § 103(a) be withdrawn.

Consequently, for the reasons discussed in detail above, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal allowance. Therefore, a Notice of Allowance is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact the undersigned representative at the below listed telephone number.

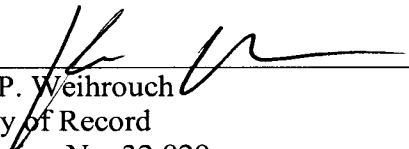
Respectfully submitted,

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